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ABSTRACT

From a group of 292 youth (269 male, 23 female) who scored 700-800 on the mathematical portion of the College Board's Scholastic Aptitude Test (SAT-M) before age 13, the subscale of 68 students who were of Asian descent (55 males, 13 females) were asked to complete a questionnaire concerning their parents' and grandparents' educational and immigratory histories. Interest in these students' backgrounds stemmed from the huge discrepancy between the percentage of Asian students in this sample (22%) and the percentage of Asian Americans in the general United States population in 1980 (1.5%). Fifty-six of the Asian-background students were of Chinese, Taiwanese, and Korean descent. Most were found to be first-generation Americans and to come from well-educated families. The phenomenal mathematical precocity of these Asian-Americans, especially females, provides a superb example of ability, ambition, and willingness to work hard that is helping set higher levels and a faster pace of educational attainment in the United States. It is predicted that they will be educational and vocational pacesetters for at least a generation or two. (JW)

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Study of Mathematically Precocious Youth
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Family Backgrounds of Young Asian Americans Who Reason Extremely Well Mathematically

Sara Delano Moore Julian C. Stanley*

Abstract

From a group of 295 youths who reason extremely well mathematically, the 68 students of Asian descent completed a questionnaire concerning their parents' and grandparents' educational and immigratory histories. Most of the students were found to be first-generation Americans and to come from quite well educated families. Certain of their characteristics are compared with those of other Asian-background and non-Asian-background groups. The phenomenal mathematical precocity of Asian Americans, especially females, provides a superb example of ability, ambition, and willingness to work hard that is helping set higher level and faster pace of educational attainment in the United States. The influx of Asian Americans is increasing rapidly, from 1.5 percent of the country's population in 1980 to 2.1 in 1985. For a generation or two, at least, they seem likely to be educational and vocational pace-setters.

In seeking across the country youths who reason extremely well mathematically, we seemed to find among those of Asian ancestry a disproportionate percentage who are first-generation

Americans. It appeared that grandchildren and great-grandchildren of emigrants to the United States from Mainland China, Taiwan, South Korea, India, the Philippines, and other Asian countries were underrepresented. There was some indication that the bulk of the highly mathematically apt Asian Americans we found had parents whose education through the bachelor's degree or the medical degree was acquired in an Asian country. The fathers of our mathematical prodigies appeared usually to have come here to work toward a PhD degree or to serve as medical interns or residents.

These were impressions, however, and not verifiable from the data we had on hand. In order to test them, we instituted the present study. Let us first consider how the mathematically talented youngsters had been identified.

Background of the Study

During the three-year period from November 1980 through October 1983, the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University sought persons from all over the country who before their thirteenth birthday scored at least 700 on the mathematical part of the College Board's Scholastic Aptitude Test (SAT) (Stanley and Benbow, 1986). In all, 292 members for SMPY's special "700-800 on SAT-M Before Age 13" group were found. Their SAT-Verbal and Test of Standard Written English (TSWE) scores were also known. In addition, each was encouraged to fill out an eight-page background questionnaire.

How remarkable is it to score 700-800 on SAT-M at age 12 or less (in SMPY's experience, as early as age 8)? At age twelve, the typical student is in the seventh grade and has not yet taken

the first course in algebra. The average college-bound male high-school senior, usually age 17 or 18, averages 499 after many years of studying high-school mathematics. Only six percent of them score 700 or more. For college-bound female high-school seniors, the respective figures are 452 and two percent (College Board, 1985). We estimate from large data bases that probably not more than about one in 10,000 twelve-year-olds would score 700 or greater on the SAT-M.

This is a truly phenomenal level of mathematical reasoning ability. Since 1971, SMPY has gathered much evidence that persons this able have great aptitude for mathematics and related subjects such as physics, engineering, computer science, and chemistry--and, in some cases, also for law, medical research, quantitative economics, and other fields that require superior quantitative ability.

In finding the base set of 269 boys and 23 girls (called the "700M group" for short), we soon noticed that the percent of its members who were of Asian ancestry, 22, greatly exceeded the 1.5 percent in the U.S. population according to the 1980 Census. (By 30 September 1985 this had risen to about 2.1%, Gardner, Robey, & Smith [1985] estimated.) That is 15 times the percentage expected in 1980.

To the 65 of Chinese, Korean, Indian, Japanese, or Filipino ancestry in this group, we added three younger siblings of members of the base group.[1] The huge discrepancy, 22% vs. 1.5%, led us to study the parental and grandparental background of the students, chiefly via a questionnaire sent to the parents.[2] After repeatedly prompting nonrespondents, we received back 60 of

the 65 questionnaires sent out. (Some basic data on the other five students were known from the initial background questionnaires, and for the three qualifying younger siblings of the original 65 we used data from their brother's or sister's questionnaires.) Most of those returned had been filled in rather conscientiously. From them we learned a great deal about emigration and immigration patterns. We wanted to know where the grandparents were born, and how the families migrated through three generations. Our focus was on this and also on educational patterns.

The following analyses show clearly that most of these youths are the product of extremely selective immigration to the United States. Apparently, up to now, many of them have enjoyed excellent heredity and environment, plus the high level of academic and professional motivation common to first-generation Americans from such backgrounds. It seems likely that many of these 68 will become excellent scientists or mathematicians. A few will probably excel in other fields.

Emigration from Asia into the United States

The early Asian population in the United States, during the late nineteenth and early twentieth centuries, was mostly Chinese and Japanese and was concentrated on the West Coast, especially in California. In employment data, the Asian population was overrepresented in service industries and unskilled labor. Its members were largely excluded from the best developed or developing parts of the economy (Bonacich, 1984).

Asian migration into the U.S. may be divided into five major time periods:

1849-1882	Many Chinese emigrating, very few other Asians; ended with the 1882 Chinese Exclusion Act.
1890-1924	Japanese immigration; ended with 1924 Immigration Act, which excluded all Asians except Filipinos.
1924-1952	Asian exclusion, including Filipinos after 1934; all Asians in the US ineligible for naturalization.
1952-1965	McCarran Act, ended racial bars to naturalization; token immigration quotas allotted to most Asian nations.
1965-present	All quotas removed; many Asians enter U.S.

Excepted from the various quotas and exclusion acts were usually students, businessmen, and professionals (Daniels, 1976). These exceptions meant that chiefly the better educated and probably more ambitious Asians were coming into the U.S. It is through these loopholes that many of the Asian families in this study who arrived in the U.S. before 1965 were allowed to enter the country.

The 68 Asian students in the sample come from a variety of backgrounds, Chinese, Taiwanese, Korean, Indian, Filipino, and Japanese (even Okinawan). The majority are of Chinese, Taiwanese, and Korean descent; these represent 56 of the 68 cases in the study. Table 1 contains a complete breakdown.

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Sixty-eight percent of the children were born in the U.S., while 85% or more of the parents and grandparents were born outside the U.S. The families of Korean descent left Korea in the mid-1960s, after the Korean War. The families of Taiwanese descent left Taiwan for the U.S. in the early 1960s (see Table 2).

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The families of Chinese descent left China early. Those grandparents who departed did so in the 1930s, or not until the late 1950s and 1960s if they came directly to the U.S. The families who did not come directly to the U.S. left China for Taiwan or Hong Kong in the late 1940s. Two-thirds of the students in the study (46 of 68) were born in the U.S. In the Chinese families, emigration from Mainland China was by the grandparents of the students, possibly when the parents were children. In the Taiwanese and Korean families, the parents emigrated.

The students in the sample do not include representatives of the more recent Asian emigration groups, e.g., Vietnamese, Thais, Cambodians, and Laotians. Because the group being studied was born not later than 1971 for the most part, these more recent groups were not old enough to participate in the search.

Education of Their Parents

In looking at the parental education levels (Table 3), one

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can see that this group has gone far in school. All of the parents graduated from high school, a feat achieved by none of the comparison groups. Many of the mothers went on to complete a bachelor's degree, and nearly half completed a graduate or professional degree. Among the fathers, an astounding 71 percent completed doctoral level degrees; 85 percent have some graduate degree. In looking at these data, one sees a trend toward lower educational levels as one moves from the 700M Asian parents to the 700M non-Asian parents to the general Asian population and finally to the overall U.S. population. It is interesting to note the consistency in that the Asians have a higher educational level both in the highly talented group of this study and in the general population.

In looking at the type of doctoral level degrees held by Asian parents and grandparents and by non-Asian parents, one notes that among the parents most of the degrees are academic PhDs, with the exception of the Asian mothers, 46% of whose doctorates are MDs. Among the doctorate-holding Asian grandparents, most have MDs, although a few of the grandfathers hold law degrees.[3] Virtually all of the MD degrees (or equivalent)[4] were obtained outside the United States. Only one mother obtained her MD in the U.S., and the information is unknown for one father.

One can easily see that these students come from exceptionally strong educational backgrounds, and this is also reflected in the degree-level goals of the general Asian American population versus the overall population. Thirty percent of the Asian students have a PhD as their degree goal, compared to 18 percent of the overall population (Ramist & Arbeiter, 1984). The range of parental education level within the 700M group seems minimal in the case of the mothers, but much greater in the case of the fathers. This discrepancy may well be due to the high number of doctoral-level degree holders among the fathers.

The majority of the parents received at least some of their college education in their country of birth. A majority of the grandparents did not attend college. Of those who did, virtually all of their education was received in the country of birth. Most of the medical degrees were also earned in the country of birth, although those who came to the U.S. usually did some post-graduate work here.

SAT Scores and Verbal Ability

Table 4 shows breakdowns of the SAT-M, SAT-V, and TSWE scores

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by sex for the Asians and non-Asians in the 700M group. The 700M non-Asian students have a male:female ratio of 16.5:1, and the 700M Asians 4.3:1. Half of all the 700M-scoring females SMPY has ever found are Asian Americans!

The females have higher average SAT-V and TSWE scores than the males in both the Asian and non-Asian groups. The Asian males have a slightly higher mean SAT-M than the non-Asian males, and the difference is quite dramatic between the two groups of girls. Among the Asian students, the girls have a higher mean SAT-M score than do the boys.

An interesting point arises when the SAT-V scores are broken down by the language spoken in the home. As might be expected, the mean SAT-V is somewhat lower in homes where no English is spoken, but the scores are comparable whether English alone or a mix of English and another language are spoken. Scores are slightly lower (483 compared with 490) for children born outsde the U.S. than those born in the U.S. No trend is seen when the scores are broken down by parental education level.

Discussion

As Ramist and Arbeiter (1984) show, Americans of Asian ancestry average higher than other groups on SAT-M. When this tendency is joined with high parental education and occupation, the results can be as dramatic as those in this report and the astounding test scores secured by Stanley, Huang, and Zu (1986). How well will this superb aptitude be used for getting fine educations? Early indications are quite encouraging.

Much parental and grandparental migration resulted in these 68 superb mathematical reasoners of Asian ancestry being in the United States. Grandparents of the majority of them were born in Mainland China (now the People's Republic of China) and moved to Taiwan (now the Republic of China). At least one of their

children came from Taiwan to the United States to earn a PhD degree or to be a medical resident, did well here, and was permitted to stay. Their children (i.e., the grandchildren) were born in the United States. Although this is the typical pattern, there were many variations and way-stations such as Hong Kong, Canada, and Singapore.

Fourteen of the 68 came from Korea, chiefly in the parent generation. Eight emigrated from India. Oddly, there are only two Japanese in the 68, and neither is an old-line West Coast resident. One, born in Japan, lives in California, and the other lives in Hawaii.

Generally, these are first-generation Americans. It is not clear why we found few second- or third-generation Americans among these youths. The parents of those were probably not as highly selected as the recent immigrants'. Also, having become acclimated to this country over several generations, these "old-line" Americans of Asian ancestry may have lost the impetus for special educational opportunities that characterizes many first-generation Americans. SMPY had identified the 700M group in order to help its members move ahead faster and more rigorously in mathematics and related subjects (Stanley, in press; Stanley & Benbow, 1986; Stanley & Stanley, 1986). This challenge to excellence was made by SMPY and accepted by a disproportionately large number of first-generation Asian Americans. It would be interesting to study the 227 non-Asians with respect to their families' patterns of immigration. From skimming the available data with this in mind, we infer that the parents and grandparents of many of them migrated to the United States. With no question

about grandparents on the questionnaire filled out by the young students as they qualified for the 700M group, and not having sent the non-Asians a supplemental questionnaire, our information is limited.

Arguments abound as to whether or not the United States is still (or ever really was) a melting pot of diverse cultures. It is clear to those of us who work with the 700M group that, despite the chauvinistic language of his day, Rudyard Kipling was correct in his "The Ballad of East and West" when he said,

> Oh, East is East, and West is West,
> and never the twain shall meet,
> Till Earth and Sky stand presently
> at God's great judgement seat;
> But there is neither East nor West,
> Border, nor Breed, nor Birth,
> When two strong men stand face to face,
> though they come from the ends of the earth!

Across their immigrant or old-time-American cultures, these 295 do have something in common to unite them, i.e., great mathematical reasoning ability. This rare talent is leading them to the same special summer programs, honors courses in high school, and fine colleges and universities. Many of them will eventually meet at a few great research universities to work toward PhD degrees in the most difficult scientific fields, and others will be together in the country's most selective law, medical, and business schools. They are infusing much vitality into educational programs and will continue to do so during the rest of the century (e.g., see Stevenson, Lee, & Stigler, 1986).

Each year since 1983 there are several hundred youngsters who could qualify for the "700-800 on SAT-M Before Age 13" group. SMPY has some contact, usually by mail or telephone, with quite a few of these. They need, however, nurturing at the home and school level. With appropriate curricular flexibility, special out-of-school programs, and proper articulation of their various educational experiences, talent for science and mathematics even at this superb level can be facilitated. Both the intellectually talented child and the society in which he or she lives will benefit greatly.

Gardner, Robey, and Smith (1985) sum up the situation well: "These new residents are having an impact on this country that far exceeds their numbers, yet Americans know surprisingly little about them. As a group, Asian Americans do not resemble other racial or ethnic minorities. Less well known is the fact that Asian Americans vary widely in their characteristics according to their cultural origins and when they arrived in the U.S."

There is a moral about immigration in these findings. If the pool of incoming talent and motivation ever dries up, our society will probably be the loser. To prevent educational anemia we need from outside continual infusions of ability wedded to ambition and willingness to work hard.

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Footnotes

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[1]These 68 students represent 64 families. All of them are from intact homes, apparently. Two of the marriages are mixed Asian/non-Asian.

[2]The questionnaire is available from the authors.

[3]More detailed information is available from the authors.

[4]In many countries, the medical degree is not a doctorate, but instead a professional bachelor's degree. In this paper, all medical degrees are treated as doctoral degrees.

Table 1

Nationalities of the 68 Asian Americans

Nationality	Number	Percent
Chinese	21	30.9
Taiwanese	17	25.0
Chinese & Taiwanese	4	5.9
Korean	14	20.6
Indian	8	11.8
Japanese	2	2.9
Filipino	2	2.9

Table 2

Emigration from Taiwan and China*

A. Emigration from Taiwan

Years	Singapore	Canada	China	Japan	U.S.	Total
1923			0/0/2			2
1955-59					0/7/0	7
1960-64	0/2/0	0/1/0			0/21/0	24
1965-69		0/1/0			0/11/8	20
1970-79		0/2/0			2/4/6	14
Unknown				0/0/2	0/4/0	6

B. Emigration from China

Years	Hong Kong	Philippines	Taiwan	Japan	U.S.	Total
1924-39		0/0/2			0/1/4	7
1943-49	0/5/8		0/6/8		0/0/3	30
1953-56	0/1/1				0/1/0	3
1967-74				0/0/4	0/4/4	12

*The number of family members emigrating in a given span of years to a given country is indicated as follows: # of children/ # of parents/#of grandparents.

Table 3

Parental Education Level (%)

A. Mothers'

Level	700M Asian[a]	700M non-Asian[b]	General Asian[c]	Whole population[c]
Less than HSG[d]	0	0.9	20.6	10.0
HSG[d]	7.4	4.6	23.5	33.0
Some college	1.5	9.6	16.4	20.2
Tech/AA/RN	7.4	8.2	6.8	8.2
BA	33.8	38.4	15.0	13.2
Some grad	4.4	e	5.4	5.6
MA[f]	25.0	27.9	12.2	9.7
PhD level[f,g]	20.6	10.5		

B. Fathers'

Level	700M Asian[a]	700M non-Asian[b]	General Asian[c]	Whole population[c]
Less than HSG[d]	0	0.5	14.9	11.4
HSG[d]	1.5	3.2	15.8	21.8
Some college	0	6.4	16.2	17.5
Tech/AA/RN	1.5	1.8	5.9	6.6
BA	8.8	27.4	17.3	17.0
Some grad	2.9	e	4.9	4.8
MA[f]	14.7	20.1	24.9	20.8
PhD level[f,g]	70.6	39.3		
Unknown	0	1.4	0	0

a. N =68

b. N = 219 (8 additional cases not known)

c. Ramist and Arbeiter (1984), p. 36

d. High school graduate

e. Not on questionnaire

f. These categories (MA, PhD) combined in Ramist data

g. Throughout this paper, the phrase 'PhD or doctoral level degree' includes both academic PhDs and professional degrees (MD, medical bachelor's, DVM, DDS, JD).

Table 4

Mean SAT Scores of 700Ms

A. SAT-M scores

	Males	Females	Overall
Asians	731	739	733
Non-Asians	727	715	726

B. SAT-V scores

	Males	Females	Overall
Asians	485	500	477
Non-Asians	522	564	524

C. TSWE scores

	Males	Females	Overall
Asians	47.5	52.3	48.4
Non-Asians	52.5*	57.2	52.8

*4 cases unknown

D. Number

	Males	Females
Asians	55	13
Non-Asians*	206	13

*8 cases not included in any of the above calculations.

Sara Delano Moore, identified at age 12 in an SMPY Talent Search, received her B.A. degree in natural sciences and classics from Johns Hopkins in May of 1986 at age 19. She attended graduate school at Oxford University during the academic year 1986-87, studying historical linguistics. Ms. Moore has had much experience as a teacher and mentor of the mathematically gifted.

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